The Impact of Variable Dosage Using Robotic-assisted Task-Specific Upper Extremity Training in Children with Cerebral Palsy

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Background: Cerebral Palsy (CP) and other acquired neurological disorders result from brain lesions that alter motor function in children. The impact of these deficits can impair a child's ability to use their upper extremity (UE) for normal daily activities such as eating and playing. Robotic-assisted therapy has been shown to improve motor function in children with CP. Training parameters such as intensity and frequency were initially based on findings from studies measuring change in adults following stroke. Based on this, high intensity (960 repetitions per session) and increased frequency (2 times per week, 9 weeks) were initially implemented for children. Early findings demonstrated improvement in UE function for children with CP; however, training sessions were long, making them difficult to complete given the shorter attention span of the pediatric population. Determining the potential impact of a shorter, more optimal, dosage of robotic-assisted therapy for children would facilitate rehab training efficiency and maximize cost effectiveness.

Purpose: The purpose of this study was to identify the impact on motor impairments and movement capacity with variances in treatment intensity (number of repetitions per session) while holding constant the frequency of the application (2 times per week, 9 weeks) for robotic-assisted UE training for children with CP.

Methods: Six children between the ages of 6 and 8 were analyzed from two separate studies evaluating the effectiveness of robotic-assisted training for UE functional improvement. The first study featured training at high intensity and frequency while the second study used lower intensity parameters but the same frequency. To be eligible for either study, children were required to have UE hemiplegia and the ability to participate in a task for up to 60 minutes. Twice weekly, each child participated in robotic training sessions consisting of either 960, 640, or 320 task-specific reaching movements of the affected UE. Each child completed a total of 16 robotic training sessions over a 9-week period as well as one pre- and one post-test session. Outcome measures included active range of motion (AROM), strength testing and tone using the Modified Ashworth Scale (MAS). The children's motor capacity was evaluated using the adaptive Fugl-Meyer scale (FM).

Results: Percent change scores were calculated for each participant for each outcome measurement. AROM results for the shoulder resulted in an average increase of 10.6% for flexion and a 13.3% increase for abduction in both the 320 and 640 groups. Shoulder external rotation increased by an average of 13.6% for all three groups. Arm strength increased an average of 12.3% for all three groups. The MAS had an average decrease in tone of 23.8% across all 3 groups. Scores on the FM increased an average of 23% with in-depth analysis revealing shoulder movement to be the primary area for motor capacity change at 96%.

Conclusion: These findings indicate that lower intensities of robotic-assisted therapy (320 and 640 repetitions) were as effective as the larger dose originally prescribed for children with CP. Outcome measures improved in all 3 groups and did not vary between dosing groups. This suggests that longer intensity sessions of robotic-assisted therapies may not be necessary to produce AROM, strength, and motor capacity changes. Further trials with more subjects are needed to validate these results.